SDA – Shot Data Acquisition and Analysis

- Purposes of SDA
  - Store to store monitoring of performance
  - Long term trends
  - Analysis of specific questions

- Tevatron stores, but also transfers to and from accumulator, recycler and MI

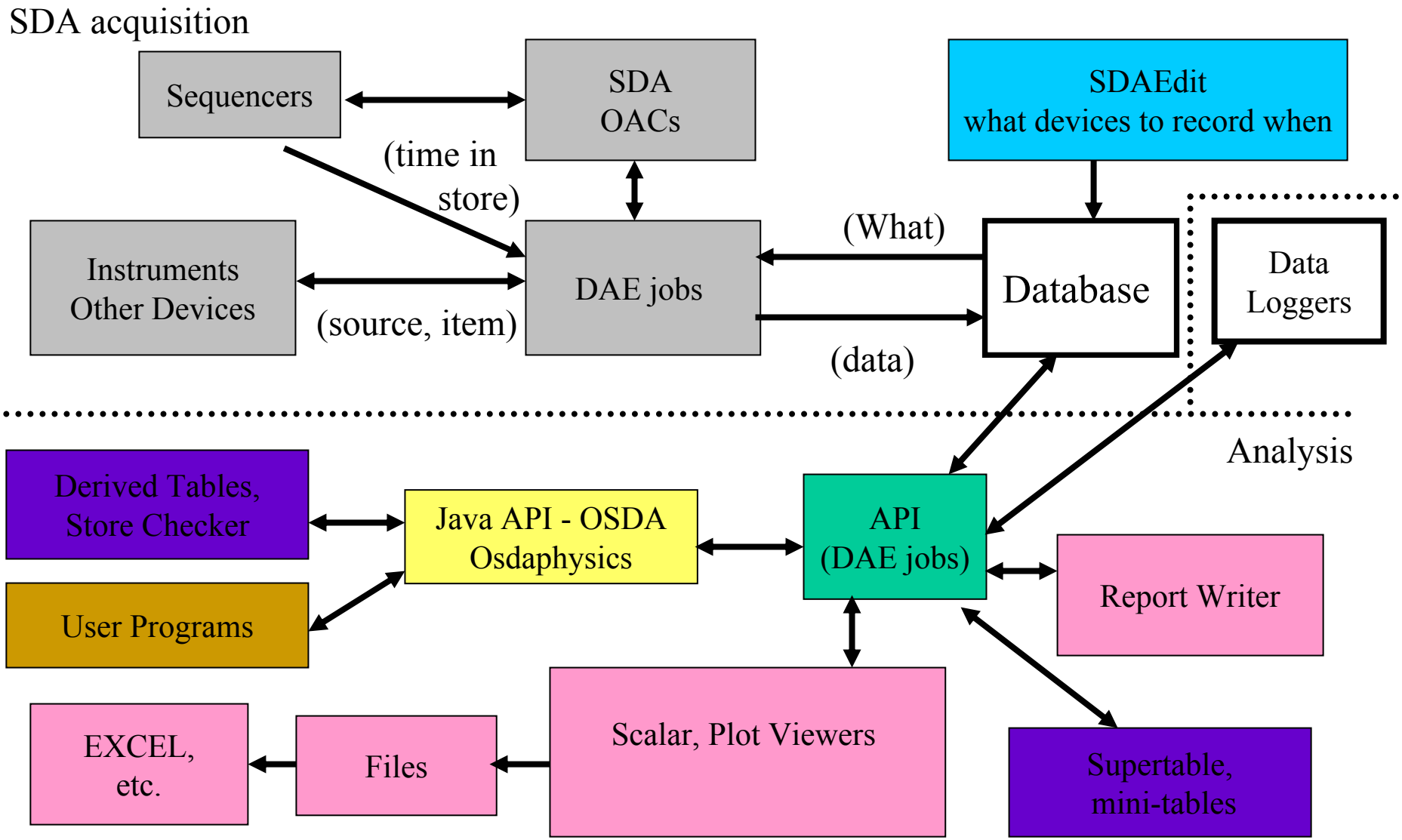
The Team

- SDA Group in Integration Department
  - K. Gounder, E. McCrory, V. Papadimitriou, J. Slaughter
  - Coordination, monitoring, analysis
- Controls Department
  - T. Bolshakov, M. McCusker, K. Cahill, B. Hendricks, J. Patrick and others
  - Infrastructure and applications
- Computing Division
  - K. Genser, P. Lebrun, S. Panacek
  - Analysis and applications

Two Aspects of Shot Data Analysis

- Acquiring and archiving the data
  - SDA - sequenced data acquisition - main source of information
    - sequencer driven processes that collect a defined set of information from multiple sources at specific times during a "store"..
  - Data loggers
    - Not "store" oriented
    - Now has a backup node for permanent storage
- Analyzing the data
  - Standard tables and plots built automatically
  - Browsers – SDA Viewer
  - Special purpose studies

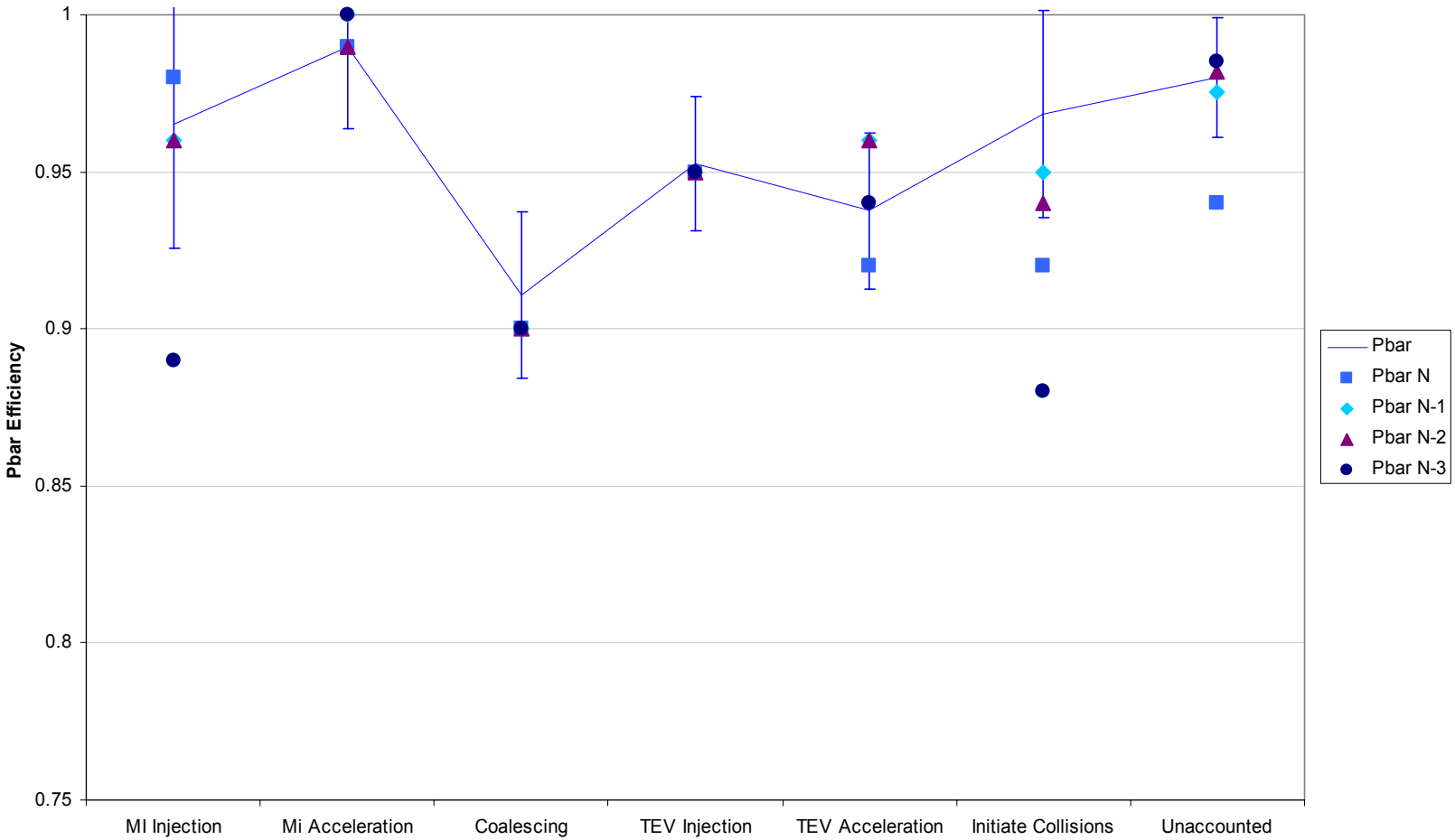
Data Acquisition and Analysis Tools Diagram



SDA Data

- Intensities
- Beam sigmas and transverse emittances
- Bunch lengths and longitudinal emittances
- BPM orbits
- Luminosities, losses, beam positions from CDF/DO
- Magnet settings, readbacks
- Misc. devices like RF control signals
- Fast Time plots of intensity devices and control settings
- Tevatron tunes
- Beams Division Documents 691, 692, 703, 705

Pbar Efficiency Through the Acceleration Chain



Analysis Tools

- Browser and Report Writer for quick studies
- Tables built automatically every store
  - Supertable and EXCEL package
  - Derived tables and associated plotting tools
  - Short summary tables
  - Tables use corrected values
- Shots scrapbook
- OSDA (Offline Shot Data Analysis) - Suite of Java classes for user programs to directly access the data, apply corrections and calculate generally useful quantities like lifetimes

Supertable

- One line per store
- Built automatically every store
- 130+ quantities of general interest
  - Dates, time on helix, length of store, how store ended
  - Luminosities, intensities, lifetimes, efficiencies, emittances at various steps in store
- Web Accessible – HTML, EXCEL
  - analysis with plots, tables also on Web
- Standard source of performance data
  - Dave McGinnis' Plots

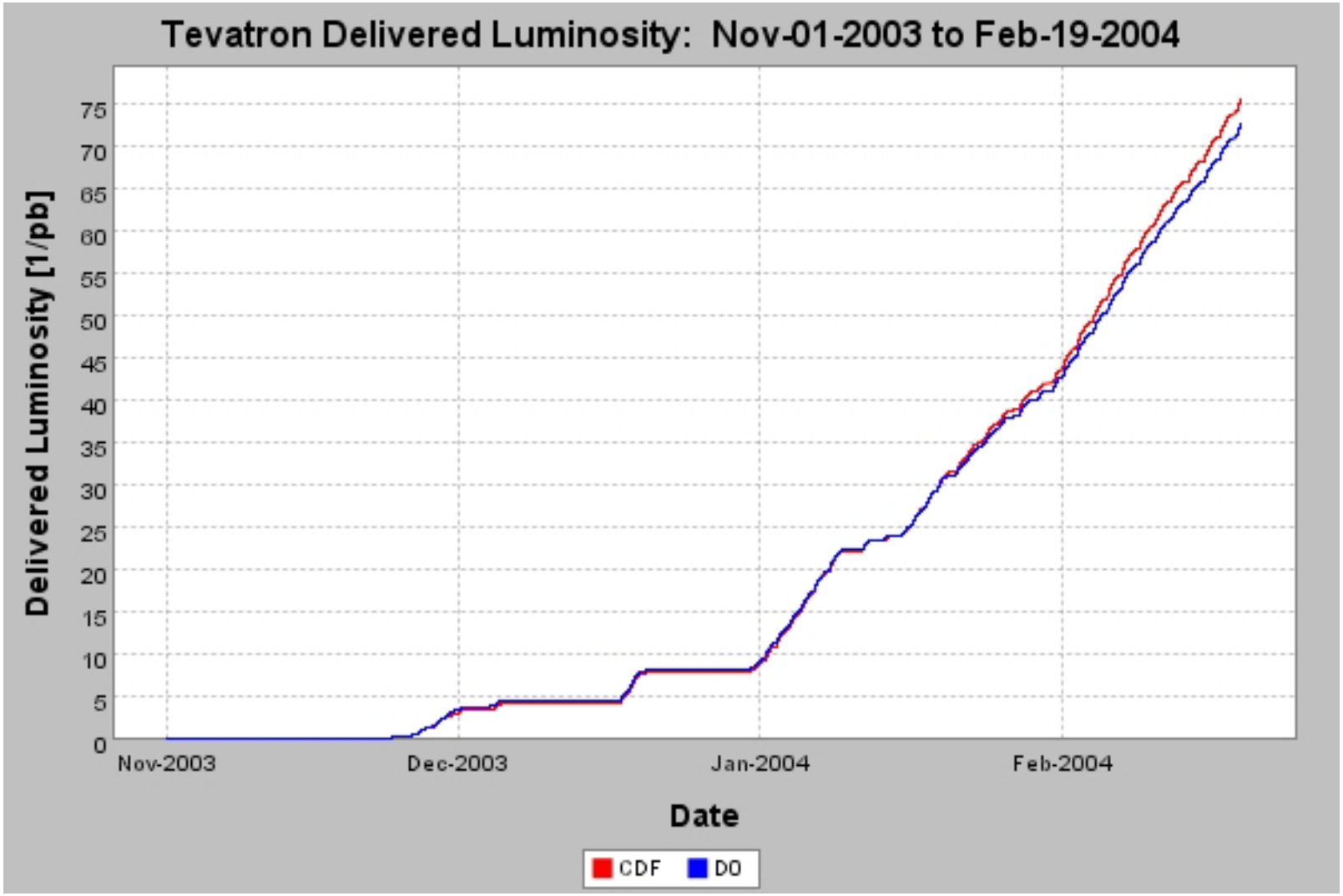
Edited Excerpt from Super Table

0 Store #	1 Date started shot set up	7 store length (hours)	8 how store ended	10 start stack	11 unstacking fraction	12 amount unstacked
3228	2/12/2004	0.22	Not Completed	135.19	0.88	119.2
3226	2/10/2004	33.31	Normal	160.39	0.86	138.6
3224	2/8/2004	36.92	Normal	149.39	0.87	129.6
3222	2/7/2004	40.18	Normal	177.19	0.81	144.2
3219	2/5/2004	31.09	Normal	173.79	0.85	147.6
3217	2/3/2004	27.98	Normal	204.19	0.8	163.4
3214	2/2/2004	33.89	Normal	208.19	0.75	156.4
3212	1/31/2004	31.37	Normal	175.19	0.78	136
3210	1/30/2004	14.65	Normal	189.39	0.62	118
3206	1/29/2004	15.1	TevQuench	80.59	0.94	75.4
3197	1/27/2004	32.38	Normal	120.39	0.9	108.6
3195	1/26/2004	2.68	Abort	145.39	0.91	131.6
3191	1/25/2004	17.9	Abort	103.79	0.93	96.2
3189	1/23/2004	35.76	Normal	142.39	0.88	125.2
3185	1/22/2004	26.41	Normal	133.19	0.9	120.4
3183	1/21/2004	23.59	Normal	120.39	0.85	102.6
3179	1/19/2004	27.76	Normal	163.19	0.86	140.4
3177	1/17/2004	22.27	Normal	172.39	0.81	140
3175	1/16/2004	25.07	Normal	176.39	0.7	123.6
3172	1/15/2004	21.48	Normal	159.99	0.51	81.2

Derived Tables- Bunch by Bunch Information

- Table per store – built automatically
  - All 6 emittances
  - Intensities
- Average and bunch by bunch information
- Use best algorithms to get physics quantities
  - Not always available directly from front-end.
- Interactive plotting interface

Integrated Luminosity Table and Plot



Store Checker

- Purpose
  - Monitor instrumentation and DAQ
  - Monitor accelerator performance – soon
- Checks SDA data for specified cases/sets
  - Min < device value < max
  - Min < (difference in time of 2 devices) < max
  - Min < (difference in value of 2 devices) < max
- Jobs run automatically every store
- "Standard" and "private" lists
- Results on WWW for "standard" list
- Lists on WWW
- Used to give email notification of initial luminosities

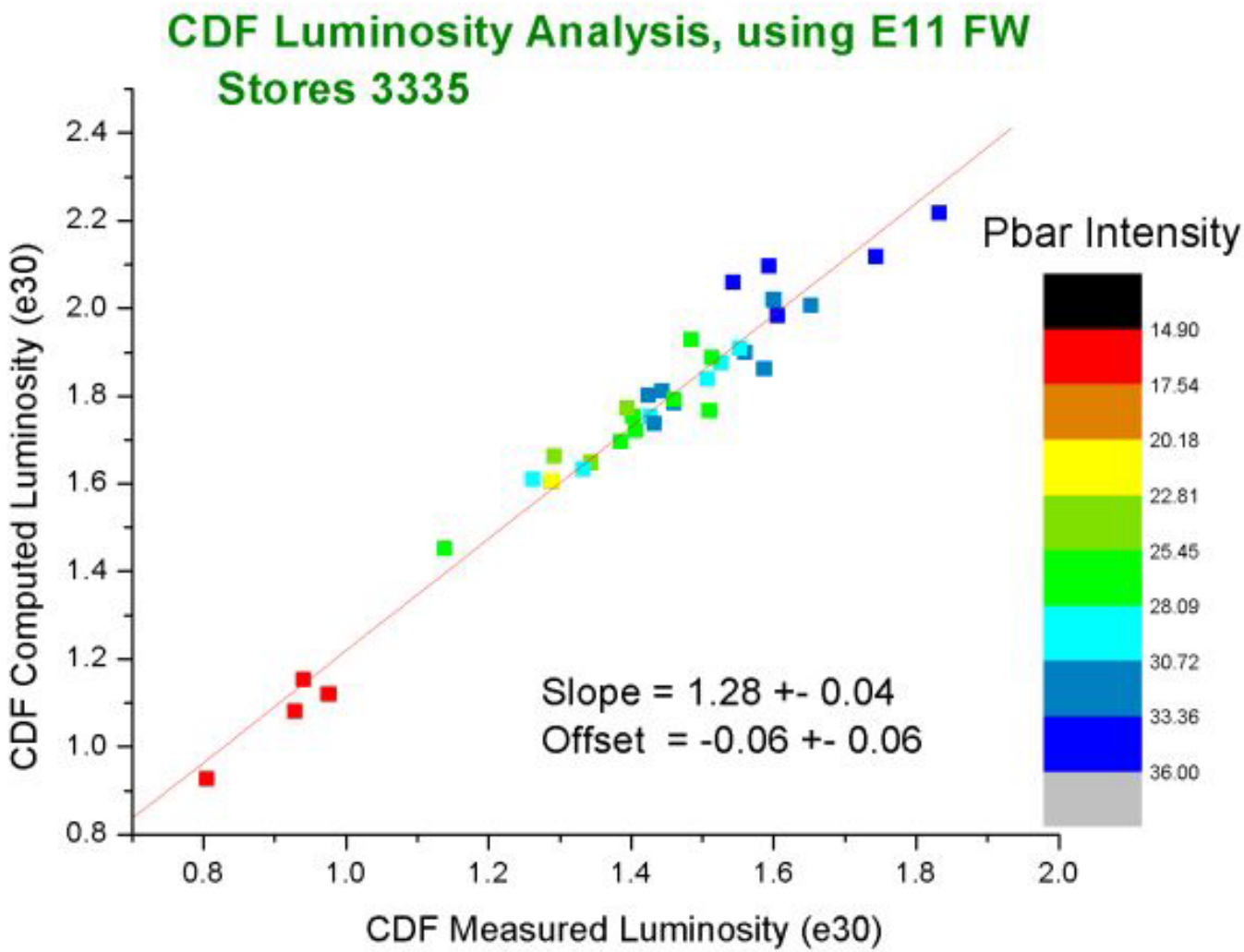
Calculated Luminosity

$$L = \frac{10^{-5} f B N_p N_{\bar{p}} (6\beta_r \gamma_r)}{2\pi\beta^* \sqrt{(\varepsilon_p + \varepsilon_{\bar{p}})_x (\varepsilon_p + \varepsilon_{\bar{p}})_y}} H(\sigma_l / \beta^*)$$

(1)

N = numbers of protons, anti-protons per bunch (10^9)
B = number of bunches (36)
f = revolution frequency (47.7 KHz)
$B_r\gamma_r$ = relativistic factor, 1045
β^* = interaction point (cm, assumed equal in x and y).
H = hourglass factor, function of σ_l, bunch length, β^*
ε = transverse emittances

Example of Analyses



Summary

- SDA home page – linked from machine elog page and controls page
  - **http://www-bd.fnal.gov/sda/**
  - Viewer – requires java 1.4.2 or higher
  - Supertable – EXCEL security must not be "high"
- SDA e-log on the Machine elogs page
- Dave McGinnis' plots
  - http://www-bdnew.fnal.gov/hq-integration/AimData/SDA_summary_files/frame.htm - linked on accelerator integration page under Headquarters on AD homepage
- Volunteers for SDA analysis always welcome